The Effect of Tax Incentives on U.S. Manufacturing: Evidence from State Accelerated Depreciation Policies

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Abstract

Accelerated depreciation policies decrease the cost of new investments by allowing firms to deduct the new investments from their taxable income more quickly. Countries around the world use these policies to stimulate business investment. To date, almost all empirical evidence of the effect of these policies relies on cross-industry variation in their generosity. Using a modified difference-in-differences framework, this paper estimates the effects of state adoption of federal accelerated depreciation policies on the U.S. manufacturing sector. The results based on this alternative source of quasi-experimental variation reinforce findings from the cross-industry literature and suggest accelerated depreciation policies have large and significant effects on capital investment.

Keywords : tax incentives, investment behavior, depreciation policy
JEL Classification : H25; E22, H5, H71

1 Introduction

Accelerated depreciation tax incentives decrease investment costs by allowing firms to deduct new capital purchases from their taxable income more quickly. These policies are widespread and costly. Steinmüller, Thunecke and Wamser (2019) document that 41 countries used accelerated depreciation policies to stimulate investment during the years 2004–2016. The U.S. federal government, which currently allows firms to immediately deduct all investment costs, is spending approximately $20 billion per year on accelerated depreciation incentives (JCT, 2017). Given their extensive use and potentially high costs, understanding how accelerated depreciation polices affect business investment is important to economists and policy makers alike.

This paper estimates how state adoption of federal accelerated depreciation policies affects investment in the U.S. manufacturing sector. Specifically, I focus on state adoption of two federal policies: Section 179 expensing and bonus depreciation. Section 179 expensing allows firms to immediately deduct all new investments below a dollar value threshold referred to as the Section 179 "allowance" from their taxable income. The benefit is phased out at higher levels of investment meaning the Section 179 deduction is only available for smaller firms that do less investment. The second policy, bonus depreciation, allows firms to deduct a "bonus" percentage – up to 100% – of the purchase price of new capital in the year it is purchased. Because bonus depreciation is available regardless of the level of investment, it decreases investment costs for larger firms.

During the sample period 1997–2013, the U.S. federal government significantly increased the Section 179 allowance and offered bonus depreciation at rates varying from 30 to 100%. Because state corporate tax bases are intimately tied to the federal base definition, when these federal policy changes were made, U.S. states had to decide how to respond. Many states chose to adopt the policies at their federal levels. Other states decided to only partially adopt the policies. Finally, a portion of states did not respond to the federal changes and offered no local versions of the federal tax incentives.

This paper uses a modified difference-in-differences empirical framework leveraging the quasi-experimental variation in state policy adoption and aggregate industry-by-state data from the Annual Survey of Manufactures (ASM) to estimate how investment responds to state accelerated depreciation policies. The modified difference-in-differences design includes terms for each policy plus their interaction to account for the fact that firms only apply bonus depreciation to capital expenditures in excess of the Section 179 allowance. I find state-level bonus depreciation and Section 179 expensing both have large and significant effects on investment activity. However, consistent with the interaction of the policies, the effect of either policy is tempered as the other is made more generous. I estimate that an increase in the state Section 179 allowance of $100,000 increases investment by 2%. State adoption of 100% bonus depreciation increases investment by 18%.

The assumption underlying the modified difference-in-differences empirical design is that state

adoption of either policy is not correlated with other coincident shocks affecting investment. I support this assumption in several ways. First, I predict state adoption of the policies based on state level characteristics. Changes in state economic, political, and demographic characteristics do not predict policy adoption. Second, I graph the evolution of gross state product and state budget gaps in the years around state policy decisions and find no concerning trends in these variables prior to policy adoption or rejection. Third, the results are estimated in the presence of industry-by-time fixed effects suggesting time-varying shocks to particular industries do not drive the results. Fourth, I perform a graphical difference-in-differences analysis illustrating how investment differs between adopting and non-adopting states in each year during the sample. No differential investment pretrends are apparent in years prior to initial implementation of the policies. Furthermore, the largest differences in investment coincide with years in which the policies were most generous. Fifth, consistent with the nature of each policy, I show that the effects of Section 179 expensing were concentrated among firms that do less investment while the effects of bonus depreciation were concentrated among firms that do more investment. While the assumption underlying the research design is fundamentally untestable, these checks significantly limit the risk that the study's findings are the result of a spurious relationship.

The primary contribution of this study is that it uses a novel source of quasi-experimental variation to reinforce the findings of a well established literature examining the investment effects of accelerated depreciation policies. To date, nearly all empirical studies in this area (especially in the U.S. context) identify the effects of accelerated depreciation policies by comparing investment in industries that typically invest in "long-lived" assets that are depreciated more slowly for tax purposes to investment in industries that invest in "short-lived" assets that are depreciated more quickly.[1] A number of recent papers in the area have used this strategy to measure the investment effects of the bonus depreciation policy (see House and Shapiro, 2008; Desai and Goolsbee, 2004; Edgerton, 2010; Zwick and Mahon, 2017; Ohrn, 2018).[2] These papers, like this study, find that accelerated depreciation policies have large effects on investment.[3]

Combining the state policy identification strategy with industry-by-state investment data has two distinct advantages over the boilerplate long-lived versus short-lived methodology. First, effects can be estimated in the presence of industry-by-time fixed effects. As a result, in contrast to other studies, this paper's findings cannot be explained by industry shocks or trends. Second, the state policy strategy avoids concerns that intra-industry competition may amplify the estimated effects.

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[1]This strategy dates back to Auerbach and Hassett (1991) and Cummins, Hassett, Hubbard et al. (1994) who first exploited the fact that accelerated depreciation policies disproportionately decrease present value investment costs for firms that invest in long-lived assets because deductions are accelerated from further in the future.

[2]Two notable exceptions are Maffini, Xing and Devereux (2019) who exploit an investment-level discontinuity to estimate the investment effects of first-year allowances in the U.K. and Tuzel and Zhang (2018), who, inspired by this study, measure how computer investment responds to state Section 179 allowances.

[3]Garrett, Ohrn and Suárez Serrato (2019) measures a strong local employment response to bonus depreciation by interacting this same industry-level identification strategy with county-level industry location data.

As an example, Patel and Seegert (2015) document that not-for-profit hospitals, which do not benefit from bonus depreciation, increased investment in response to bonus depreciation-induced investments made by for-profit hospitals operating in the same market.

The nature of the data used in this study yields a second substantive contribution. The industry-by-state ASM data is aggregated from establishment-level – as opposed to firm-level – survey data. As a result, investment responses to state accelerated depreciation policies consolidate both within-establishment increases in investment and reallocation of investment activity from one state to another. Because the majority of studies in the literature use firm-level data, they do not account for capital mobility responses.[4] Accordingly, the elasticities I estimate are slightly larger than those based on panel data that capture only within-firm responses. Because the slightly-larger elasticities I estimate capture both avenues of response, they are more relevant than within-firm elasticities from the perspective of state policy makers hoping to stimulate investment.

By documenting, for the first time, that state accelerated depreciation policies affect investment, I also contribute to a recently reinvigorated literature showing that state corporate taxation and corporate tax provisions can have large effects on real economic outcomes. Seminal papers include Helms (1985), Wasylenko and McGuire (1985), Papke (1991), and Bania, Gray and Stone (2007) while more recent entries are exemplified by Wilson (2009), Suárez Serrato and Zidar (2016), Heider and Ljungqvist (2015), Ljungqvist and Smolyansky (2016), Suárez Serrato and Zidar (2018), and Giroud and Rauh (2019).

The remainder of the paper is organized as follows. In Section 2, I describe both accelerated depreciation policies in detail and document how the policies evolved at the federal and state levels during the sample period. Section 3 presents a simple Neoclassical investment model to more formally predict how investment responds to the accelerated depreciation policies and their interaction. The data sources and empirical design are described in Sections 4 and 5. Section 6 presents the baseline empirical results, robustness checks, and heterogeneity. In Section 7, I explore effects on outcomes other than investment. Section 8 calculates investment elasticities and compares them to other studies in the literature. Section 9 concludes.

2 Bonus depreciation and Section 179 expensing

Typically, businesses in the U.S. cannot immediately deduct the full cost of newly purchased assets from their taxable income. Instead, businesses deduct the value of the assets over time according to the Modified Accelerated Cost Recovery System (MACRS) (detailed in IRS Publication 946). MACRS specifies the life and depreciation method for each type of potential investment. For equipment, lives can be 5, 7, 10, 15, or 20 years and the depreciation method is called the "declining

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[4]Giroud and Rauh (2019) use disaggregated establishment-level data to show how state corporate income tax rates affect reallocation of business activity.

balance switching to straight line deduction method." In the absence of accelerated depreciation policies, the present value of depreciation deductions associated with \$1 of new equipment is equal to

$$z^0 = \sum_{t=0}^{T} \frac{1}{(1+r)^t} D_t,$$

where T is the life of the asset, D_t is the portion of the dollar that is depreciated in year t, and r is the rate used to discount future cash flows.

Bonus depreciation allows firms to immediately write off an additional "bonus" percentage – which I denote as b – of the total cost of new equipment purchases in the first year. The remaining $1 - b$ percent of the equipment cost is depreciated according to MACRS rules. With bonus depreciation, the present value of \$1 of depreciation deductions is $b + (1 - b)z^0$.[5]

Federal bonus depreciation was first enacted in 2001 at a rate of 30%. In 2003, the additional first year deduction was increased to 50%. The incentive was discontinued in 2005, but was reinstated in 2008 at a 50% rate. Bonus depreciation remained available to businesses at the 50% rate through 2018, but for in 2011 when the federal bonus depreciation rate was increased to 100% and firms were allowed to immediately deduct or simply to "expense" all new equipment costs.

Section 179 of the U.S. Internal Revenue Code allows businesses to expense limited amounts of equipment investments. Thus, Section 179 expensing is equivalent to 100% bonus depreciation for qualifying assets. Firms are allowed to deduct new capital assets dollar-for-dollar up to the "Section 179 allowance," the maximum Section 179 deduction that a taxpayer may elect to take in a year. Critically, the Section 179 deduction is reduced dollar-for-dollar after the "Section 179 limit" is reached.

From 1997 to 2001 the Section 179 allowance was modest and grew annually from \$18,000 to \$24,000. The allowance jumped to \$100,000 in 2003 and grew to \$125,000 in 2007 before vaulting to \$250,000 in 2008. The allowance saw another big rise in 2010 when it was increased to \$500,000 where it remained through 2018. Panels (a) and (b) of Figure 1 display the federal Section 179 allowance and federal bonus depreciation rates during the years 1997–2013.

To better understand how the Section 179 allowance and limit determine the maximum Section 179 deduction consider the deduction in 2003. The Section 179 allowance was \$100,000 and the limit was \$400,000. Panel (c) of Figure 1 shows how the maximum Section 179 deduction varies with the amount of equipment investment. For firms investing less than \$100,000, all investment costs can

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[5]Notice that bonus depreciation increases the present value of depreciation deductions by $b(1 - z^0)$. The benefit of bonus depreciation is, therefore, larger when z^0 is smaller or when MACRS rules dictate that equipment has a longer life and is depreciated more slowly. Based on this observation, the majority of the existing literature (referenced in Section 1) uses cross-industry differences in the long-livedness of average investments to identify the effects of bonus depreciation and accelerated depreciation policies more generally. Appendix A provides an example further illustrating the effect of bonus depreciation on the present value of depreciation deductions.

be immediately deducted under Section 179 rules. Firms investing between $100,000 and $400,000, can immediately deduct the full allowance, as well. But, for every dollar a firm invests more than the $400,000 limit, the deduction is decreased by a dollar. As a result, no deduction is available to firms investing more than $500,000 during the 2003 tax year. Because the allowance dictates the amount of investment to which the deduction applies, I focus on this number in analyzing the effects of the policy.

[**Figure 1 about here**]

When both Section 179 expensing and bonus depreciation are available, the policies interact. Firms first take the Section 179 deduction, then apply bonus depreciation and MACRS rules to the remaining investment. To see this interaction, take, for example, the Section 179 and bonus depreciation deductions together in 2003 when bonus depreciation was offered at a 50% rate. Panel (d) of Figure 1 shows the amount of bonus depreciation deduction available to a firm at different investment levels assuming the firm takes full advantage of the Section 179 deduction. Firms that invest less than the Section 179 allowance of $100,000 deduct all of their investment under Section 179 and, therefore, receive no benefit from bonus depreciation. In contrast, firms investing more than $500,000 are not allowed to write off anything under Section 179 rules, but instead deduct 50% of their investment costs immediately under bonus depreciation. Firms that invest between $100,000 and $500,000 expense as much as they can under Section 179 rules and then apply bonus depreciation on the remaining investment.

This example demonstrates three key insights. First, Section 179 applies mainly to smaller firms doing less investment while bonus depreciation applies to larger firms that, on average, do more investment. As a result, we would expect the investment effects of Section 179 allowances to be concentrated among firms that do less investment and the effects of bonus depreciation to be concentrated among firms that do more investment. The second insight is that increasing the Section 179 allowance will mitigate the effect of bonus depreciation on investment because the base on which bonus depreciation operates is smaller when the Section 179 allowance is higher. The third, more nuanced insight is that the effect of increased Section 179 allowances is also mitigated at higher bonus depreciation rates. When the Section 179 allowance is increased from I_1 to I_2, it decreases the present value cost of all newly eligible investments (from I_1 to I_2). If those newly eligible investments were already eligible for generous bonus depreciation, then the decrease in the present value cost is smaller and the effect of increasing the allowance on investment should also be smaller.

Zwick and Mahon (2017) estimate that 100% federal bonus depreciation – or, equivalently, Section 179 expensing – decreases the present value cost of eligible investments by 5.46%. State bonus depreciation and Section 179 expensing are inherently less valuable to firms than federal incentives because the resulting deductions are taken against the state corporate tax rates which are

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significantly lower than the 35% federal rate in place during the analysis period. Among adopting states, the average state corporate income tax rate during the sample period was 7.0%. Because the state tax rate is only 20% as high as the federal rate, state bonus depreciation adoption only decreases the purchase price of new investments by 1.092% (= $0.2 \times 5.46\%$). Appendix B calculates the effect of state accelerated depreciation policies on the user cost of capital accounting for a variety of federal and state tax provisions. The calculations show very similar effects of the policies on the user cost of capital.

2.1 State adoption of federal accelerated depreciation policies

Because state corporate tax bases are intimately tied to the federal base definition, when the federal policies were altered, states had to choose whether to adopt the federal policies. Figure 2 depicts which states fully or partially adopted bonus depreciation during the sample period. When bonus depreciation was first introduced, 17 states fully adopted the 30% federal rate. Five other states adopted the federal policy at rates less than 30%. Three states, Wyoming, Nevada, and South Dakota had no corporate income taxes during the sample period and, therefore, could not adopt the federal incentive. The remaining 25 states did not offer bonus depreciation. In 2008, when bonus depreciation was reintroduced, 12 states fully adopted while five partially adopted the 50% rate. Overall, Figure 2 shows significant cross-state and within-state variation in adoption.[6]

[**Figure 2 about here**]

[**Figure 3 about here**]

Figure 3 depicts which states' tax codes conformed to the federal Section 179 allowance. In 2001, when the federal Section 179 limit was $24,000, nearly every state also allowed for full expensing of investments up to the federal limit for state tax purposes. As the Section 179 allowance increased during the years 2003–2011, most – but not all – states also increased their state Section 179 allowance and limits in step. The largest drops in the percentage of adopting states were in 2003, when the federal allowance jumped from $24,000 to $100,000, and in 2010, when the allowance increased from $250,000 to $500,000. Despite these large drops, by the end of the sample, more than 60% of states still conformed to the federal Section 179 rules.

States that adopted the federal Section 179 rules are more likely to fully or partially adopt bonus depreciation. As shown in Appendix Table C2, in 2004, of the 35 states that conformed to federal Section 179 rules, 21 adopted bonus depreciation at some level. Of the the remaining states that did not conform to the federal Section 179 rules, none of them offered bonus depreciation at any rate. A very similar pattern is apparent during later years of the sample. The overlap between the policies highlights the need to understand their interactive effects on investment.

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[6]Appendix C provides more information detailing state adoption of both policies during the sample period.

3 Predicting responses

To better understand how the two policies and their interaction affect investment, in this section, I present a stylized two period model in which a representative firm maximizes investment in the presence of Section 179 expensing and bonus depreciation. The firm starts Period 1 with retained earnings, X, and must decide how much to invest, I, and how much to pay out as a dividend, $D = X - I$. I generates net profits according to the concave production function $f(I)$. Profits are taxed at rate τ_c.[7] The investment economically depreciates at rate δ, but can only be depreciated for tax purposes and deducted from taxable income at rate z. Investors can also purchase a government bond that pays fixed rate r and therefore discount period 2 dividends by $1 + r$. The firm's maximization problem can be written as

$$\max_I V = (X - I) + \frac{(1 - \tau_c)f(I) + \tau_c zI + (1 - \delta)I}{1 + r}.$$

Both bonus depreciation and Section 179 expensing affect z.

$$z = b + (1 - b)z^0$$

where b is the bonus depreciation rate (i.e. 0.3, 0.5, 1) and

$$z^0 = \begin{cases} 1 & \text{if } I \leq \text{Section 179 allowance and} \\ z_{MACRS} & \text{if } I > \text{Section 179 allowance.} \end{cases}$$

When the investment level is less than the Section 179 allowance, the full cost of the investment can be depreciated in the first year and $z = 1$. When the investment level is greater than the Section 179 allowance, z^0 is equal to the MACRS depreciation rate, z_{MACRS}.[8]

The firm's first order condition with respect to I is

$$f'(I) = \frac{r + \delta - \tau_c z}{1 - \tau_c}$$

and $\partial I / \partial z > 0$, meaning that the profit maximizing level of investment increases as the investment can be depreciated more quickly. How bonus depreciation and Section 179 expensing affect I (through z) is slightly more complicated because the marginal effect of each policy depends on the

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[7] τ_c is a generic corporate tax rate that can be construed to represent the federal, state, or a combined rate.

[8] For simplicity, this specification ignores the Section 179 phase-out that occurs after I reaches the Section 179 limit. Because ASM data on firm-level investment is not very precise, any additional empirical predictions that could be made by adding the phase-out region are difficult to test empirically.

level of the other. The effect of bonus depreciation on investment is

$$\partial I/\partial b \begin{cases} = 0 \text{ if } z^0 = 1 \text{ when } I \leq \text{ Section 179 allowance), but} \\ > 0 \text{ if } z^0 < 1 \text{ when } I > \text{ Section 179 allowance).} \end{cases}$$

When the investment level is less than the Section 179 allowance, bonus depreciation does not increase z and does not incentivize investment. On the other hand, for marginal investments over the Section 179 allowance, bonus depreciation increases z and incentivizes investment. Put simply, investments under the Section 179 allowance are already immediately expensed and therefore cannot benefit from bonus depreciation. At higher Section 179 allowances, bonus depreciation has no effect for a larger portion of investment.

The effect of an increase in the Section 179 allowance on investment also depends on bonus depreciation rate, b. When the Section 179 allowance is increased, z^0 is now equal to 1 for newly eligible investments. For these newly eligible investments, $\partial I/\partial z^0 > 0$, but $\partial^2 I/\partial z^0 \partial b < 0$, meaning the effect of increases in the Section 179 allowance are smaller at higher bonus rates. In simpler terms, an increase in the Section 179 allowance simply isn't worth as much to newly eligible investments when a bonus percentage is already deducted in the first year.

To reinforce this intuition, imagine increasing the allowance from \$100,000 to \$250,000 when the bonus depreciation rate is either 0 or 50%. When the bonus depreciation rate is 0%, investments from \$100,000 to \$250,000 essentially go from no additional first year deduction to being fully deductible. When the bonus depreciation rate is 50%, investments from \$100,000 to \$250,000 go from being 50% deductible in the first year to 100% deductible. The effect of Section 179 expensing on the present value cost of these newly eligible investments is lower when the bonus depreciation rate is higher.

These comparative statics suggest two symmetric, empirically testable hypotheses that motivate the study's empirical design. First, state bonus depreciation will increase investment and the effect will be concentrated among states that have low Section 179 allowances. Second, increases in state Section 179 allowances will increase investment and the effect will be concentrated among states that offer lower bonus depreciation rates.

Corollary hypotheses are generated by recasting these comparative statics in terms of firm investment levels. The first corollary hypothesis is that state adoption of bonus depreciation will increase investment, and the effect will be concentrated among firms that invest at levels beyond the Section 179 allowance. Second, state conformity to Section 179 allowances will increase investment, and the effect will be concentrated among firms that invest at levels below the Section 179 allowance. Section 6.5 tests these corollary hypotheses by exploring heterogeneity using a proxy for investment level.

Before moving on, I note a potential shortcoming of this simple model. The model predicts that

the effect of each policy increases in τ_c. However, this may not be the case if firms are choosing to reallocate investments across state lines. In most instances, generous depreciation rules and high tax rates will not be preferred to slower depreciation and lower corporate income tax rates. Because the model is based on a representative firm operating in a single jurisdiction, it abstracts from this reallocation effect. I further discuss this nuance and empirically explore how state corporate income tax rates interact with the policies in Subsection 6.5.

4 Data sources

To estimate the effects of state adoption of bonus depreciation and Section 179 expensing, I rely on business activity data from the ASM, state bonus depreciation data from Lechuga (2014), hand collected state Section 179 allowance data, and time-varying state economic, political, and demographic control variables from various sources. Table 1 provides descriptive statistics for the analysis sample.

[**Table 1 about here**]

4.1 Manufacturing data

Measures of business activity come from the ASM and the Economic Census, both products of the U.S. Census Bureau. The sample period is the years 1997-2013. The ASM is conducted annually in all years except for years ending in 2 and 7. In those years, corresponding data are available from the Economic Census. The ASM provides sample estimates and statistics for all manufacturing establishments with one or more paid employees, which is the entire Economic Census sample. As a result, statistics in all years are comparable.

The unit of observation in the study is state-level 3-digit North American Classification System (NAICS) industries. The choice to use industry-by-state data (as opposed to state-level data) is made for two reasons. First, the more granular data allows me to control for industry-by-time shocks. This constitutes an improvement over nearly all other studies in the literature because papers that use cross-industry differences in policy generosity to identify effects cannot control for time-varying shocks that apply to one industry but not another. Second, the industry-by-state level data allow me to explore heterogeneity in effects by investment level. As Section 179 expensing should be most valuable for smaller firms that do less investment and bonus depreciation should be most valuable for larger firms that do more investment, heterogeneity along this margin helps to support the internal validity of the study.

There are 21 3-digit NAICS manufacturing industries and 1022 observational units used in the baseline analysis.[9] The primary business outcome I investigate is the log of real capital expenditure

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[9]If each NAICS × State unit was represented there would be 1050 units. Some industries are either not represented in some states or there are too few establishments to report statistics while maintaining confidentiality.

which I denote **Log(CapX)**. In Section 7, I also explore the effects of the policies on the log of compensation per employee, the log of employees, and the log of real total shipments, a measure of total output. From the ASM data, I also construct **Invest Level** equal to capital expenditure divided by the number of establishments in each state-industry unit in the year 2002.[10]

4.2   State policy variables

Derived from Lechuga (2014), **State Bonus** is the state bonus depreciation rate. The variable can be thought of as an interaction between the federal bonus rate and **State Adoption**, which takes on values between 0 and 1 and describes the extent to which a state adopts the federal bonus rate. State Adoption is equal to 0 if an observational unit is located in a state that fully rejects the policy in a given year. State Adoption is set equal to 1 for states that adopted the policy at the federal level. When state bonus is adopted at X% of the federal rate, State Adoption is set to X/100.

State **179**, the state-level Section 179 allowance, was hand collected for each state in each year 2000–2014 from department of revenue documents, web pages, and interviews with state employees. Like State Bonus, State 179 can be expressed as an interaction between the federal Section 179 allowance and **State Conformity**, which describes the extent to which a state's Section 179 allowance matches the federal allowance. The State 179 variable is scaled so a one unit increase denotes a $100,000 increase in the state Section 179 allowance.

4.3   Time-varying state controls

Time-varying state level data is used to explore any systematic differences between states that do and do not adopt federal bonus depreciation and Section 179 rules. From The Book of States data, I construct **Corp Rev %** (the percentage of total state revenue derived from state corporate income taxes), **Budget Gap** (total state deficit as a fraction of total state revenue), **Democratic Legislator %** (percentage of state legislators that identify as Democrats), and **Democratic Governor** (an indicator equal to 1 if the governor is a Democrat). I take **Corp Tax Rate** (the top marginal corporate income tax rate in each state) from The Tax Foundation. I take **State Population** from Census and construct **Real GSP per capita** from Census and BEA data.

5   Empirical design

Because state adoption of each policy is correlated and because both are designed to spur investment, estimating the effect of either policy alone will lead to biased estimates. Furthermore,

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[10]The number of establishments data needed to construct Invest Level is only available via the Economic Census which is taken in years ending in 2 and 7. I rely on 2002 data because it is very close to the first implementation of bonus depreciation and prior to the first major increases in the Section 179 allowance. Because the year is so early, it is unlikely that either policy will dramatically affect average investment per establishment, especially when industry-by-time fixed effects are included in the analysis.

following the logic laid out in Section 3, because the effect of one policy is predicted to decline when the other is offered at more generous levels, the empirical specification must include the interaction between the two policies to provide unbiased estimates of the effect of each policy.[11] Accordingly, I estimate the effect of both policies simultaneously using the following regression equation

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\begin{aligned}
\ln(\text{CapX})_{jst} = \beta_0 &+ \beta_1[\text{State Bonus}_{st}] + \beta_2[\text{State 179}_{st}] \\
&+ \beta_3\big[[\text{State Bonus}_{st}] \times [\text{State 179}_{st}]\big] + \mathbf{X}'_{\mathbf{st}}\gamma + \sigma_t + \nu_{js} + \zeta_{jt} + \psi_s + \epsilon_{jst}
\end{aligned}
\tag{1}
$$

where j denotes NAICS 3-digit industries, s denotes state, and t denotes time. In addition to the policy variables, equation (1) includes an interaction between the two policies. The fully specified model also includes industry-state fixed effects (ν_{js}) to control for time invariant determinants of business activity, year fixed effects (σ_t) to control for aggregate trends, time-varying state-level controls ($\mathbf{X}'_{\mathbf{st}}$), state-specific linear time trends (ψ_s) to account for state-level changes in the business environment, and finally, industry-by-year fixed effects (ζ_{jt}) to control for changes in business activity that occur at the industry-level.[12] Because State Bonus is equal to State Adoption interacted with the federal rate and State 179 is equal to State Conformity interacted with federal Section 179 allowances, β_1 and β_2 can both be interpreted as difference-in-differences (DD) estimates and equation (1), which contains State Bonus, State 179, and their interaction represents a modified DD methodology.

β_1 is interpreted as the percentage increase in investment experienced by a state that fully adopts 100% federal bonus depreciation relative to the increase that a fully rejecting state experiences when neither state allows for any Section 179 expensing. Similarly β_2 is the impact of an additional $100,000 in Section 179 allowances when there is no state bonus depreciation. The β_3 coefficient captures how much β_1 or β_2 change as State Bonus or State 179 are increased. More precisely β_3 is equal to the change in the effect of bonus depreciation adoption (β_1) that occurs when state Section 179 allowances increase by $100,000. Because state bonus depreciation is predicted to be less effective when Section 179 allowances are high and Section 179 allowances are predicted to have less effect when bonus depreciation is adopted at higher rates, the interaction term is predicted to be negative.[13]

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[11] Columns (5)–(7) of Appendix Table D1 show that, consistent with this logic, estimating the effect of either policy alone or the effect of both policies without the interaction produces downward biased estimates.

[12] The state-specific linear time trends are important to include for two reasons. First, because the accelerated depreciation policies vary at the state-level over time, state-by-year fixed effects cannot be included in the model. Second, because Section 179 allowances increase in a linear fashion over time, estimates of the effect of State 179 will be especially sensitive to linear trends in investment, positive or negative, generated by unobserved factors. Adding the state-specific linear trends tempers this concern.

[13] In order to jointly estimate β_1, β_2, and β_3, state bonus adoption and state Section 179 conformity cannot be perfectly collinear. Table C2 describes the overlap of the two policies during the first and second episodes of bonus. Because, there is significant variation in bonus adoption among Section 179 conforming states, all three coefficients can be jointly estimated.

5.1 Predicting state adoption

The assumption underlying the modified DD identification strategy is that investment in states that adopt the policies would follow the same path as investment in states that do not in the absence of the policies. While this assumption is inherently untestable, the year, industry-by-time, and state-by-year fixed effects as well as state-specific linear time trends included in most specifications minimize the concern that this assumption is violated. Even in the presence of these fixed effects and trends, a particular concern is that states that adopted the policies were observably different in terms of economic, demographic, or political characteristics and that these differences are correlated with investment patterns.

As a first pass in assessing whether adopting states are observably different, I use a linear probability model to regress three adoption outcomes, (1) state adoption of bonus depreciation, (2) state adoption of Section 179 expensing, and (3) state adoption of both policies on state economic, demographic, and political characteristics. Table 2 presents the linear probability model results. Specifications (1)–(3) include just year fixed effects to control for aggregate trends. Specifications (4)–(6) add state fixed effects. Specifications (7)–(9) add state-specific linear time trends. The results presented in specifications (1)–(3) suggest that, indeed, states that adopt the policies have difference characteristics than than those that do not. However, when state fixed effects or state fixed effects and state-specific time trends are included, these observable differences disappear suggesting that **changes** in state productivity, population, corporate tax rates, budget gaps, and political representation do not predict adoption of bonus depreciation, Section 179, or both policies. Because the DD methodology, which includes observational-unit fixed effects, relies only on changes in variables within a unit, the Table 2 results suggest economic, political, and demographic differences between adopting and non-adopting states will not undermine the underlying DD assumption.[14]

[**Table 2 about here**]

As a second check, in Appendix F, I create event study graphs that show how GSP growth rates and state budget gaps evolve in three situations: when state bonus depreciation was initially implemented in 2001 or reimplemented in 2008, when states choose not to conform to federal Section 179 allowances, and when states adopt or reject federal bonus depreciation in years other than 2001 or 2008. 9 of the 10 event study graphs included in the appendix show no divergence in GSP growth rates or budget gaps prior to adoption or rejection. The one exception shows state budget gaps were increasing in states that adopted bonus depreciation in years other than 2001 or

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[14]In Appendix E, the Table 2 analysis is re-estimated using lagged time-varying state characteristics. Specifications (4)–(6) are also re-estimated using a logit model. Results are qualitatively equivalent to those presented in Table 2 except decreases in state GSP per capita predict adoption of bonus depreciation when using the Tobit estimator. Because state business investment and GSP per capita are positively correlated, this result would only downward bias the estimated effect of bonus depreciation on investment.

2008.[15] While these diverging pretrends are concerning, budget gaps are likely negatively correlated with investment. Therefore, this pattern is likely to downward bias the estimated effects of state adoption of bonus depreciation. Consistent with this logic, I find larger bonus depreciation effects when I eliminate these states from the sample (specification (6), Table 3).

Overall, changes in state economic, political, and demographic characteristics do not seem to predict state adoption of accelerated depreciation policies during the sample period. Furthermore, GSP growth and budget gaps – for the most part – do not diverge between adopting and non-adopting states. These analyses support the underlying DD assumption that investment in adopting and non-adopting states would trend similarly in the absence of policy adoption. Despite this conclusion, in Section 6.1, I use Entropy Balancing methods (Hainmueller (2012)) to verify that level differences in state characteristics are not responsible for the estimated policy effects.

6 Effect of state accelerated depreciation policies on investment

Table 3 presents estimates of coefficients from equation (1) describing the effect of State Bonus, State 179, and their interaction on investment. The baseline specification presented in column (1) presents estimates of the effect of policy adoption in the presence of year, NAICS × State, and NAICS × year fixed effects as well as state-specific linear time trends and time-varying state controls.[16] Standard errors in this specification and throughout the paper are clustered at the state-level.[17]

The coefficient on State Bonus is 0.180 and statistically significant at the 95% level. The 0.180 parameter indicates that state adoption of 100% federal bonus depreciation increases investment by 18% when state Section 179 allowances are set to $0. The State 179 coefficient of 0.0206 is smaller, but still significant at the 95% level, indicating that an increase in state Section 179 allowances of $100,000 increases manufacturing investment by 2.06% when state bonus rates are set to 0%. While this effect is smaller, consider that the federal Section 179 allowance has been set at $500,000 since 2010. As a result, fully conforming to federal Section 179 levels after 2010 increases manufacturing investment just over 10% if no federal bonus depreciation is adopted.

[**Table 3 about here**]

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[15]The states were Florida in 2004, Illinois in 2011, Iowa in 2003, Maine in 2011, North Carolina in 2003, Oregon in 2010, and Pennsylvania in 2011.

[16]Specifications (1)–(4) of Table D1 present models with varying levels of fixed effects and controls. Across all models, adoption of bonus depreciation has a large and significant effect on investment. Consistent with the observation that federal Section 179 allowances increase at a nearly linear rate during the sample period, the effect of State 179 is most precisely estimated in the presence of state-specific linear time trends.

[17]Following Cameron and Miller (2015), because both State Bonus and State 179 vary at the state level and over time, standard errors are clustered at the state level. Appendix G constructs p-values for the baseline specification policy coefficients using randomization inferences methods. These situation-specific p-values are smaller than those presented in Table 3 suggesting the p-values produced by the state-level clustering procedure are conservative.

The coefficient on the interaction term is also statistically significant but negative in sign, meaning that, as hypothesized, an increase in the generosity of one policy undermines the effect of the other. The -0.0420 magnitude means that for every \$100,000 increase in Section 179 allowances, adoption of 100% bonus depreciation stimulates 4.2% less investment. The interaction coefficient can also be interpreted as the decrease in the effect of State 179 when state bonus depreciation is increased from 0 to 100%. Thus, the interaction term suggests that the effect of Section 179 expensing decreases by 4.2% when 100% bonus depreciation is adopted by a state.[18]

6.1 Matching based on state characteristics

The analysis presented in subsection 5.1 showed that states that adopted the federal accelerated depreciation policies are different in terms of economic, political, and demographic characteristics than those that did not.[19] To combat the concern that these differences may drive the empirical results, I rely on the Entropy Balancing methods developed in Hainmueller (2012) to match adopting and non-adopting units based on the suite of economic, political, and demographic controls used throughout the paper. The method calibrates unit weights so that the means of the control variables in the treatment sample match the means of the controls variables in the control sample. Entropy Balancing is especially useful in this context because the effect of continuous treatment variables can be estimated after the sample is reweighted.[20]

In specification (2) of Table 3, states that did not adopt bonus depreciation are reweighted so that their characteristics match those of states that adopted bonus depreciation in at least 9 of the 11 years the policy was offered federally. In specification (3), states that adopted federal Section 179 rules during the entire sample period are matched to those that did not. In specification (4), states that both adopted bonus depreciation in 9 of the 11 possible years and adopted federal Section 179 rules during the entire sample period are matched to those that did not. Across all three Entropy Balanced specifications, the coefficients on all three policy variables have the same direction, are similar in magnitude, and maintain at least 95% statistically significance levels. In sum, the Entropy Balanced results suggest that differences across states in economic, political, or demographic characteristics are not responsible for the estimated effects of state accelerated depreciation policies.

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[18]In Appendix H, I use the baseline estimates to plot the marginal effect of adopting each policy at the federal level during each sample year assuming states adopt the other policy at the average adoption level.

[19]Recall, the same analysis showed that these differences disappear in the presence of state fixed effects and therefore do not violate the underlying DD identification assumption.

[20]I rely on Entropy Balancing to match units rather than more traditional matching techniques because the identification strategy relies on within-state changes in the generosity of the policies, not just whether a state adopted the policy or not. Because traditional matched difference-in-differences methods can only estimate the effect of binary treatments, these techniques cannot accommodate the policy variation upon which this study is based.

6.2 Lasso-selected controls

n specification (5) of Table 3, I use the Lasso machine learning technique (Tibshirani, 1996) to choose time-varying state controls from an expanded suite of potential covariates that includes the baseline economic, political, and demographic controls plus a full set of interactions between each. Policy estimates are stable in the presence of the only Lasso-selected control, the log of GSP per capita, suggesting the results are robust to the set of control variables chosen by algorithm in addition to the baseline set.

6.3 Eliminating abnormal bonus depreciation adopters

The analysis in Appendix F suggests that states that adopt bonus depreciation in years other than 2001 or 2008 experience increased budget gaps prior to adoption. As noted earlier, if anything, this pattern is likely to downward bias the estimated effects of state adoption of bonus depreciation. Specification (6) of Table 3 eliminates these abnormal adopters from the sample. Consistent with the prediction of downward bias, the coefficients on all three policy variables increase in size relative to the baseline specification. The State Bonus coefficient is now only marginally significant, but this is likely due to the smaller sample size. The specification (6) result suggests that these states, which may adopt bonus depreciation based on changes in their budget gaps, are not driving the empirical results and do not substantial bias the baseline estimates.

6.4 Graphical Difference-in-Differences Analysis

If state adoption of accelerated depreciation policies affects investment, then investment should trend similarly in industry-state units that do and do not adopt the federal policies prior to adoption and then diverge upon adoption. Furthermore, differences in investment patterns between adopting and non-units should be largest in years when the policies are offered at more generous levels. To test whether these patterns reinforce the baseline results, I present the following graphical difference-in-differences analysis.

I estimate the impact of state adoption of bonus depreciation in each year by replacing the State Bonus variable in specification (1) with an interaction between adoption and a series of year indicators:

$$\sum_{k=1997}^{2013} \beta_1^k \left[\text{State Adoption}_{s,t} \times \mathbb{1}[\text{Year}_k] \right].$$

The coefficients β_1^{1997}–β_1^{2014} are the difference in log investment between adopting and non-adopting units in each year.[21] Panel (a) of Figure 4 presents these coefficients.

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[21]Note that State Adoption$_{s,t}$ varies over time because different states adopt in each year. To create comparable units prior to policy implementation, adopting and non-adopting status in years 1997–2000 and 2005 is set equal to

Panels (a) and (b) show that, in years 1997–2000, before federal bonus depreciation was first implemented, there is no difference in investment behavior between adopting and non-adopting units. In 2002, investment begins to increase for adopting units. The divergence is even stronger in years 2003–2004 when the bonus rate is increased to 50%. When bonus depreciation is turned off in 2005–2007, investment differences decrease. In 2008, when federal bonus depreciation is reinstated, investment by units in adopting states diverges sharply from investment by units in non-adopting states. The largest divergence between adopting and non-adopting units is in 2011, when federal bonus depreciation is offered at 100%. When bonus depreciation is scaled back in 2012, the difference again converges. Panels (c) and (d) which focus on adoption of bonus depreciation in 2001 and 2008 separately each show similar investment pretrends and diverging investment behavior upon adoption. Overall, consistent with the baseline estimates, this graphical analysis suggests state adoption of bonus depreciation has a substantial effect on investment.

I alter the estimation procedure in two ways to examine the effects of state Section 179 adoption. First, instead of replacing State Bonus in Specification (1), I now replace State 179 with

$$\sum_{k=2003}^{2014} \beta_2^k \left[\text{State Conformity}_{s,t} \times \mathbb{1}[\text{Year}_k] \right].$$

Second, I limit the analysis to years after 2003 because prior to 2003 nearly all states fully conformed to the federal Section 179 allowance level.

Panel (a) of Figure 5 presents the coefficient estimates. Panel (b) adds these coefficients to the average investment trend. Investment trends similarly in units in adopting and non-adopting states prior to 2008 when the federal allowance was set near $100,000. Coefficients are larger (although not always statistically different from zero) after 2008 when the federal allowance increased to $250,000 and then $500,000. While the graphical evidence is less strong than in the case of bonus depreciation, overall, Figure 5 shows state adoption of federal Section 179 allowances led to increased investment by industries in adopting states after 2008.

6.5 Heterogeneity in effects of state accelerated depreciation policies

The simple model presented in Section 3 demonstrates that bonus depreciation only affects firms that invest beyond the Section 179 allowance level. Additionally, Section 179 expensing should only affect marginal investment decisions for firms that invest below the Section 179 limit. To

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the average State Adoption observed in years 2001–2004 and adopting and non-adopting status in years 2005–2007 is set equal to the average State Adoption observed in years 2008–2010.

implement a simple test of these predictions, I reestimate the baseline specification (column (1) of Table 3) including interactions between State Bonus, State 179, and State Bonus × State 179 with Invest Level, a proxy for the level of investment undertaken by each firm. Invest Level is equal to the 2002 per establishment level of investment for each NAICS × State observation. Invest Level is scaled so each unit translates to a $100,000 increase in investment per establishment.

[**Table 4 about here**]

Column (1) of Table 4 presents the Invest Level heterogeneity results. The State Bonus coefficient is now statistically indistinguishable from zero, but the State Bonus × Invest Level interaction is positive and statistically significant suggesting that the effect of adoption of state bonus depreciation is, as expected, larger for units that do more investment. The State 179 coefficient is now larger than in the baseline case and the State 179 × Invest Level coefficient is negative and marginally statistically significant. Together these coefficients imply that, as predicted, the effects of state Section 179 allowances are concentrated among firms that do less investment. The State Bonus × State 179 × Investment Level coefficient is negative and statistically significant suggesting the interaction between the policies is concentrated among firms that do more investment. The sign of this coefficient is consistent with the logic that Section 179 allowances only mitigate the effect of bonus depreciation at high allowance levels for firms that do lots of investment. Overall, the investment level heterogeneity results are entirely consistent with the nature of the two policies. The adoption of bonus depreciation has larger investment effects for firms that do more investment while conformity to federal Section 179 allowances mainly affects firms that do less investment. This result further reinforces the internal validity of the study.

A second heterogeneity prediction of the Section 3 model is that the effects of both policies should be concentrated in states with higher corporate income tax rates. However, as noted in Section 3, accelerated depreciation provisions are unlikely to cause firms to reallocate investments from low tax to high tax states. Therefore, reallocated investment is more likely in low tax states. If reallocation effects constitute a substantial portion of the investment response, then they may swamp out the predicted tax rate heterogeneity.

To explore state tax rate heterogeneity, in specification (2) of Table 4, I interact State Bonus, State 179, and State Bones × State 179 with **High Tax**, an indicator equal to 1 if the maximum state corporate income tax rate is equal to or above 7%, the average (and median) rate in the analysis sample. All three interaction coefficients are statistically insignificant implying the effect of state accelerated depreciation policies are not concentrated among states with high corporate income tax rates. This result suggests that reallocation of investment across state lines makes up a non-negligible amount of the measured investment response.

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7 Other outcomes

Overall, the results presented in Section 6 show that adoption of both accelerated depreciation policies increase investment and that the effect of either policy on investment is mitigated as the generosity of the other increases. I now turn to exploring the effects of state accelerated depreciation policies on other outcomes of interest. Columns (3)–(5) of Table 4 show the effects of State Bonus, State 179, and State Bonus × State 179 on log employment, log compensation per worker, and log output. The estimates suggest that bonus depreciation has no effect on employment or output. However, bonus depreciation does have an effect on compensation per employee. Adoption of 100% state bonus depreciation with no Section 179 allowance is estimated to increase compensation per worker by just under 2%, although the result is only statistically significant at the 10% level. Increasing state Section 179 allowances by $100,000 decreases this effect by just over 0.5%. A natural explanation for these three results is that there are short-run adjustment costs to hiring more workers. As a result, the same number of employees may work longer hours, resulting in more compensation. If this is the case, the fact that only bonus depreciation increases compensation may be because larger firms are more able respond on this hours / compensation margin. While investment may increase output in the long-run, a null effect in the short-run is plausible especially if installing new machinery temporarily slows production.

Interestingly, the employment results contrast with Garrett, Ohrn and Suárez Serrato (2019), who show that federal bonus depreciation had significant positive effects on employment in local labor markets. The divergence in findings is likely due to differences in response timing. Garrett, Ohrn and Suárez Serrato (2019) show that almost all of the local employment response due to industry-level differences in bonus depreciation generosity happened in the 2001–2005 period. If state bonus depreciation adoption also increased employment only in the 2001-2005 period, the modified DD methodology that I use would likely show no effects as adoption of the federal policy at higher rates during the later period had no effect on employment.

8 Constructing and comparing investment elasticities

The primary contribution of this study is to use a new source of quasi-experimental variation to asses whether and to what extent accelerated depreciation policies affect investment. Thus far, the study has provided a resounding 'yes' to the question of whether accelerated depreciation policies affect investment. To answer the question of extent, I now calculate the elasticity of investment with respect to its the net of tax rate, $1 - \tau_f - \tau_s z$.[22] I then compare these estimates to those based on the cross-industry literature and attempt to explain discrepancies.

I begin by calculating the bonus depreciation investment elasticity. To construct the elasticity,

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[22]This is equivalent to the present-value after tax cost of $1 of investment

I divide the baseline estimated percent increase in investment due to state adoption of 100% bonus depreciation of 18.0% by the percent change in net of tax rate due to 100% bonus depreciation. As described in Section 2, 100% state bonus depreciation decreases the net of tax rate by 1.092 cents per dollar of investment and decreases $1 - \tau_f - \tau_s z$ by 1.883% assuming a federal rate of 35%, a state corporate rate of 7%, and $z = 0.88$ from Zwick and Mahon (2017).[23] Dividing the 18% by 1.883% yields an elasticity of investment with its after-tax cost of 9.55.

Section 179 expensing also decreases the after-tax present value cost of eligible investments by 1.883%.[24] Simply dividing the 2.06% State 179 effect by the 1.833% decrease in investment costs yields an elasticity of 1.12. This understates the real effect of the policy because each $100,000 increase in the Section 179 allowance from $0 to $500,000 only hits about 13% of the units in the sample.[25] Thus, we can multiply the 1.12 by 1/0.13 to scale the elasticity to measure the effect of decreasing the cost of investment by 1.833% for the full sample. This yields a state Section 179 elasticity of 8.62, which is relatively close to the 9.55 state bonus depreciation elasticity. The remaining disparity is likely due to the fact that plants that do more investment are more likely to be part of large multi-state corporations that can reallocate investment across states to take advantage of state accelerated depreciation policies.

Because of the additional complications introduced in scaling the Section 179 elasticity, I prefer to focus on the bonus depreciation elasticity in comparing this study to others. Three recent papers use variation in accelerated depreciation policies to measure the elasticity of investment with respect to the net of tax rate. Using industry-level variation created by federal bonus depreciation, Zwick and Mahon (2017) report an elasticity of 7.2 for all U.S. firms. Ohrn (2018) uses the same estimation strategy but focuses on publicly traded firms and reports an elasticity of 3.98. Maffini, Xing and Devereux (2019) exploit changes in the definition of Small Medium Enterprises in the UK, which bestowed medium sized firms with more generous first year depreciation allowances, and find elasticities between 8.3 and 9.9.

Of these three studies, the Zwick and Mahon (2017) elasticity is most comparable to the 9.55 bonus depreciation elasticity. Both studies estimate responses to the same type of accelerated depreciation policy and over roughly the same time period. The 9.55 elasticity I estimate is 32.6% larger than the 7.2 elasticity from Zwick and Mahon (2017). Because the Zwick and Mahon (2017) estimate is based on firm-level tax return data and an industry-level treatment, it does not capture reallocation effects as I do in this study. Therefore, if all of the difference were due to reallocation responses, then contrasting the two elasticities would suggest 32.6% of the investment response to state accelerated depreciation policies is due to reallocation of investment across state lines.[26]

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[23]See Appendix I for more details on the derivation of the 1.883% decrease in the net of tax rate.

[24]Recall Section 179 expensing is akin to 100% bonus depreciation for eligible investments.

[25]In 7,765 of the 11,979 units for which Invest Level is available, investment is less than $500,000 per year. Therefore 13% of units invest in each $100,000 interval from 0 to $500,000.

[26]Giroud and Rauh (2019) find a slightly higher ratio of within firm reallocation to total response (approximately 50%) when they estimate the effect of changes in state corporate tax rates on employment using linked

This reallocation-effect difference between the two elasticities highlights the use of aggregated state-industry level data based on establishment-level surveys in this study. The use of this aggregated data means within-establishment responses and reallocation of investment are combined into a single response. On the one hand, this does not allow for a disentangling of reallocation and non-reallocation effects or estimation of deeper structural parameters of the firm. On the other hand, from the perspective of the state policy maker whose goal is to attract mobile capital, disentangling the effects is largely unnecessary. Whether the response is generated by within-firm increases or reallocation does not matter with regard to state economic growth or state tax revenues. As a result, the more aggregate elasticity represents a sufficient statistic, at least in most settings, for the state policy maker.

9   Conclusion

This study has used a novel source of quasi-experimental variation – state adoption of federal incentives – to measure the effects of accelerated depreciation policies on investment in the U.S. manufacturing sector. I find large effects of state adoption of both bonus depreciation and Section 179 expensing on investment. Consistent with the fact that firms can only apply bonus depreciation to investment in excess of the Section 179 allowances, I find the effect of either policy is mitigated as the other is made more generous. By demonstrating significant investment responses to the policies, the results presented herein corroborate a large number of papers that use industry-level differences in the generosity of depreciation policies to identify investment effects (Auerbach and Hassett, 1991; Cummins, Hassett, Hubbard et al., 1994; House and Shapiro, 2008; Desai and Goolsbee, 2004; Edgerton, 2010; Zwick and Mahon, 2017; Ohrn, 2018).

While a litany of checks were used to verify the validity of the empirical design and robustness of the findings, the study is limited in several ways. First, because the study uses state-by-industry data, the methodology cannot distinguish between within-establishment investment responses and reallocation of investment from one state to another. Comparing the elasticity of investment with respect to the net-of-tax rate derived from this study's results to the Zwick and Mahon (2017) elasticity suggests approximately a third of the response to state accelerated depreciation policies is driven by reallocation. Combining the state-level policy variation with matched firm-establishment data could yield more insights into the relative size of each type of investment response.

A second limitation is that because the identifying variation is cross-sectional in nature, the estimates provided – like those using industry-level variation – do not speak to the aggregate effects of the accelerated depreciation policies. However, if anything, the aggregate effects seem to be larger than cross-sectional elasticities would suggest. Edge and Rudd (2011) study bonus depreciation in the context of a linearized New Keynesian model and find aggregate elasticities

firm-establishment data.

exceed the cross-sectional elasticities found by House and Shapiro (2008).[27]

A final limitation is that the study focuses exclusively on investment behavior in the manufacturing sector. Although the manufacturing sector represents the largest share of equipment investment among any sector in the U.S. (BEA, 2019), knowing how state accelerated depreciation policies affect other sectors is crucial in designing effective and well-targeted tax incentives.
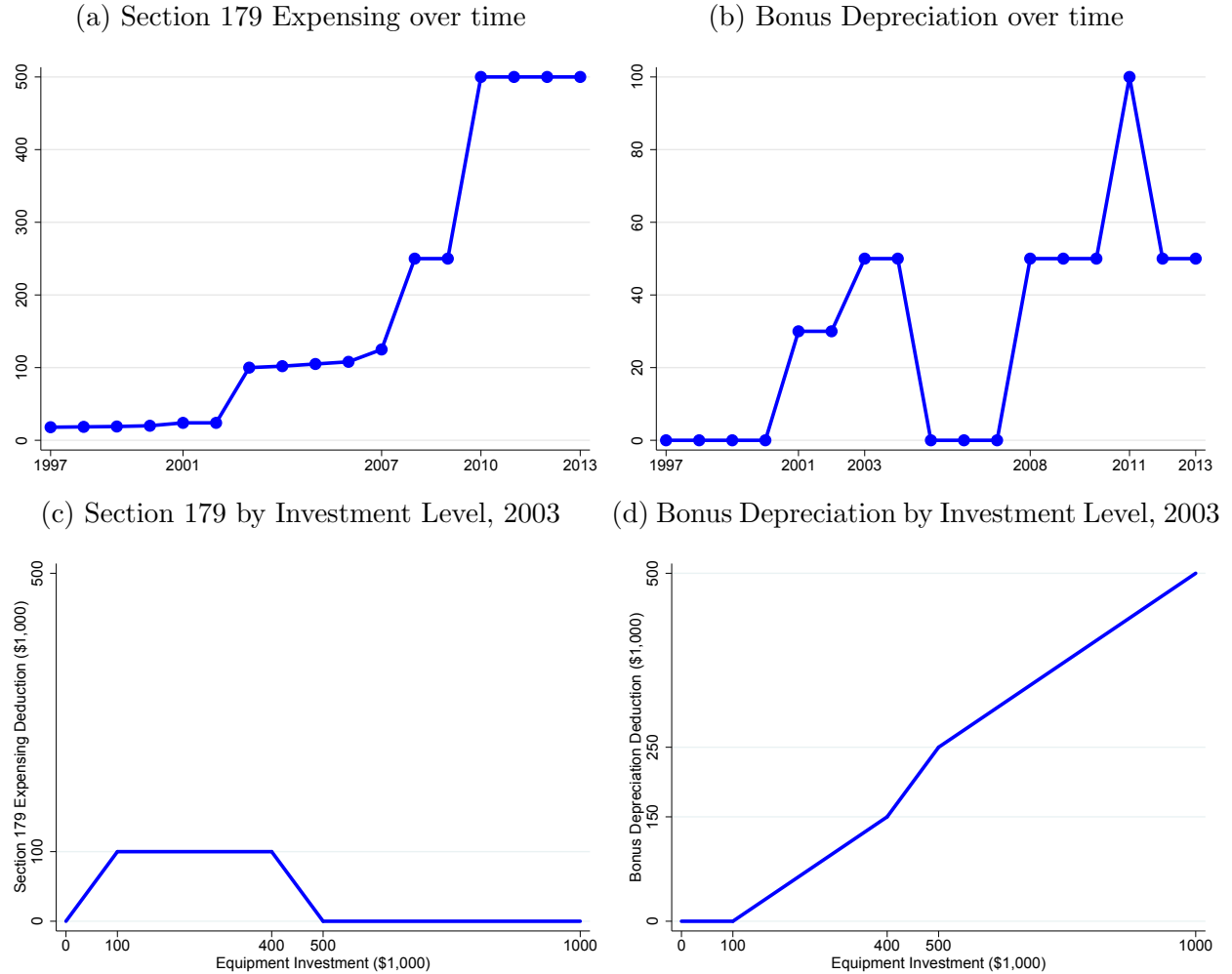
Despite these limitations, this study's results have several important implications for policy makers. First, accelerated depreciation incentives work to stimulate business investment. As a result, these policies can be used to promote economic growth and to counter business cycles. Second, expensing provisions that phase out at higher-levels of investment effectively target firms that do less investment and are, ostensibly, smaller. Policies like Section 179 expensing are, therefore, well-suited to promote business investment among "main-street" businesses as opposed to larger corporations. Third, due to the high mobility of capital, accelerated depreciation provisions can have extra-large effects when implemented at the subnational-level. Therefore, accelerated depreciation policies are especially cost-effective tools for state and local policy makers looking to stimulate investment.

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[27]Focusing on the first episode of bonus depreciation (2001–2005), House and Shapiro (2008) find investment elasticizes between 6 and 14.

10   Figures

Figure 1: Federal Accelerated Depreciation Deductions

(a) Section 179 Expensing over time

(b) Bonus Depreciation over time

(c) Section 179 by Investment Level, 2003

(d) Bonus Depreciation by Investment Level, 2003

Notes: Panels (a) and (b) show the federal Section 179 allowance and federal bonus depreciation rates during the years 1997–2013. Panel (c) plots the maximum federal Section 179 expensing deduction that a firm can elect by varying amounts of eligible investment as governed by 2003 tax law, when the Section 179 allowance was $100,000 and the Section 179 limit was $400,000. Panel (d) of Figure 1 plots the maximum federal bonus depreciation deduction that a firm can elect at varying amounts of eligible investment assuming they take full advantage of Section 179 expensing. The bonus depreciation rate in 2003 was 50%.

Figure 2: State Adoption of Federal Bonus Depreciation
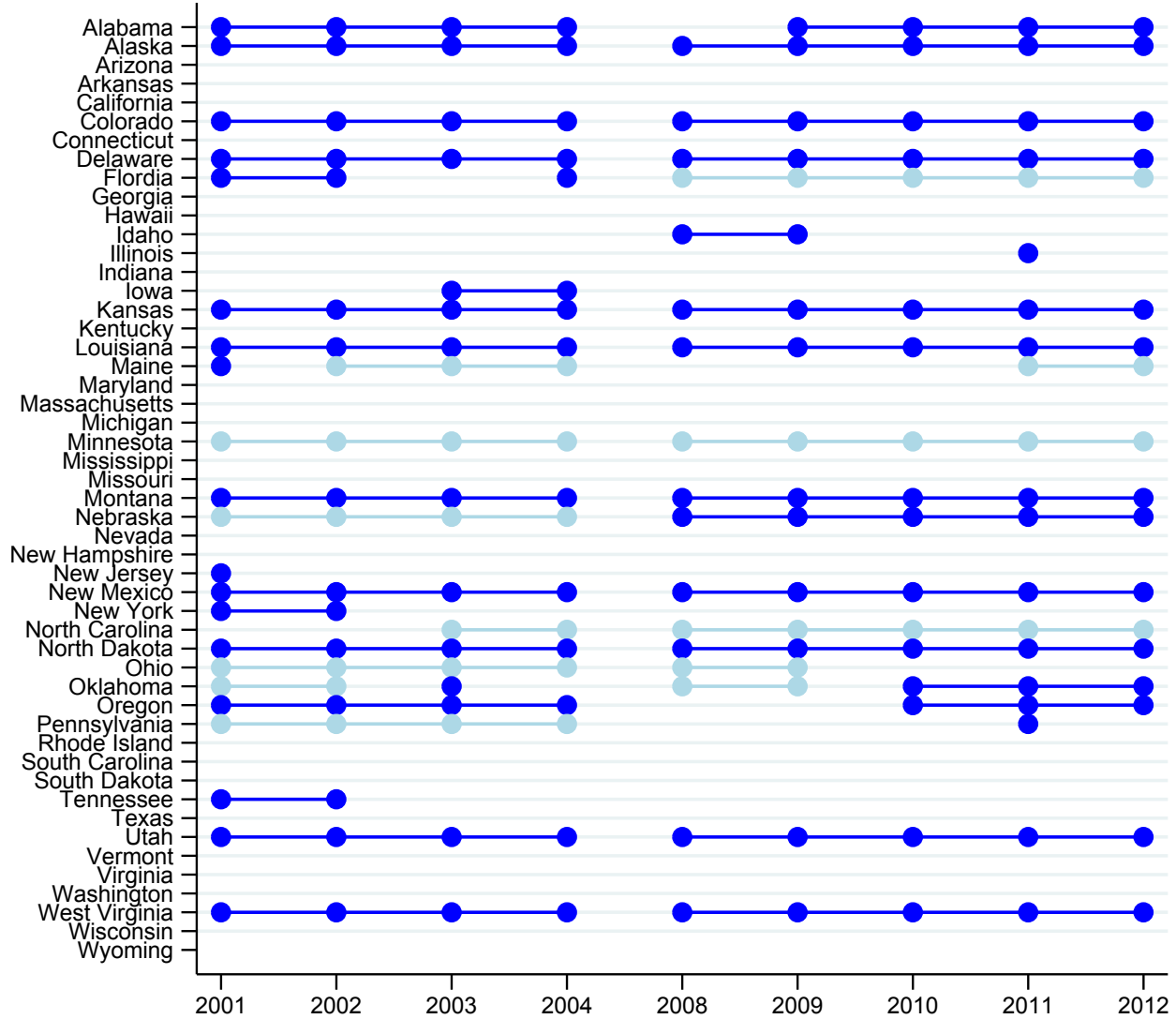
Notes: Figure 2 describes adoption of bonus depreciation by states during the years 2001–2004 and 2008–2012. Dark blue dots represent full adoption. Light blue dots represent less than full adoption. Florida adopted at 1/7th federal rates after 2008. Firms in Maine had to postpone their 2002 bonus deductions by 2 years. Maine adopted at 5% of the federal rate in 2003 and 2004 and 10% of the federal rate in 2011 and 2012. Minnesota adopted at 20% federal rates. Nebraska adopted at 32% federal rates prior to 2008. North Carolina adopted at 30% of federal rates in 2003 and 2004 and at 15% of federal rates in 2008–2012. Ohio adopted at 1/6th the federal rate before the corporate franchise tax was phased out in 2010. Oklahoma adopted at 20% of federal rates in 2001–2002 and in 2008–2009. Pennsylvania adopted at 3/7th of the federal rates prior to 2008. Source: Bloomberg BNA

Figure 3: State Conformity to Federal Section 179 Allowances
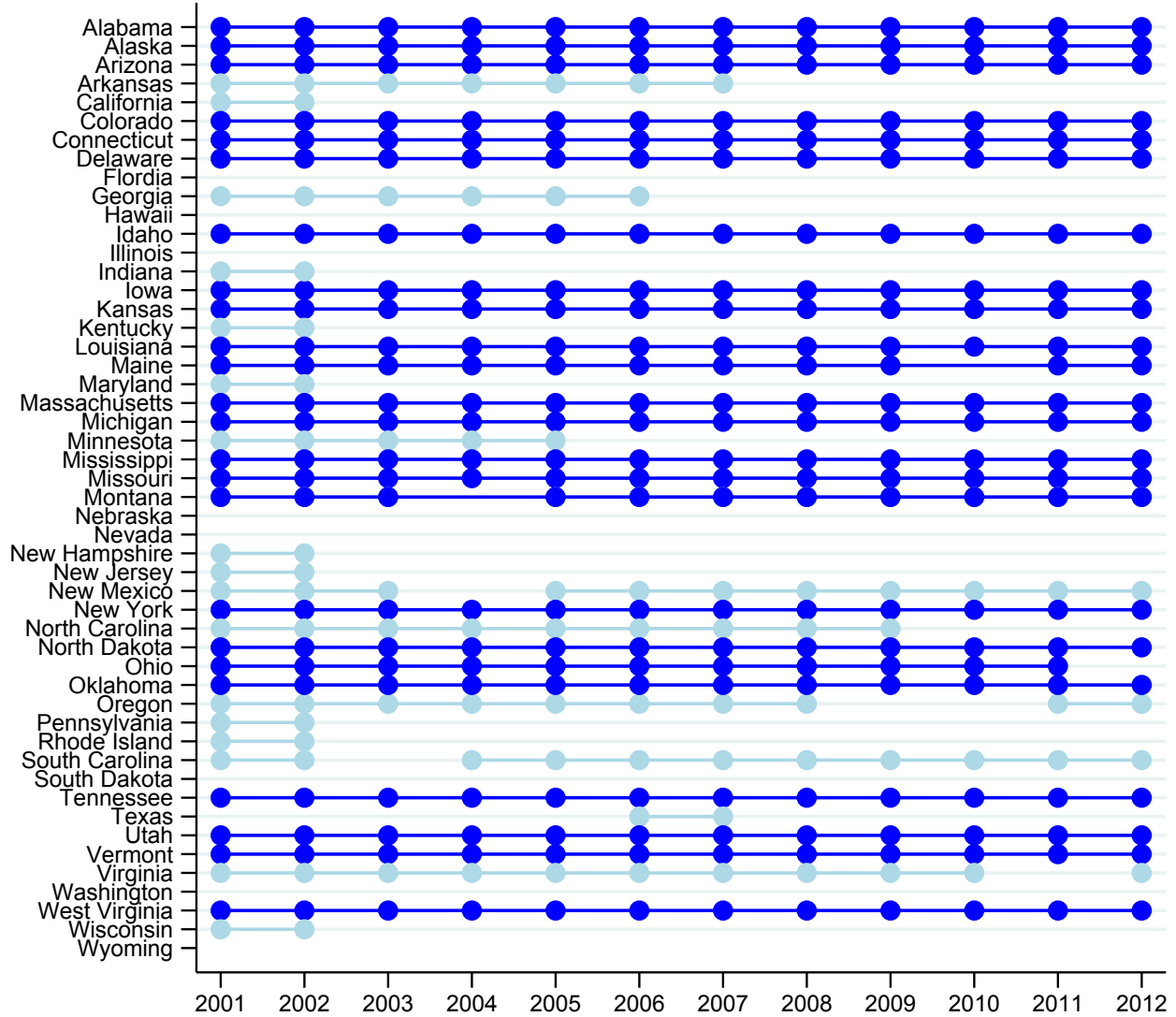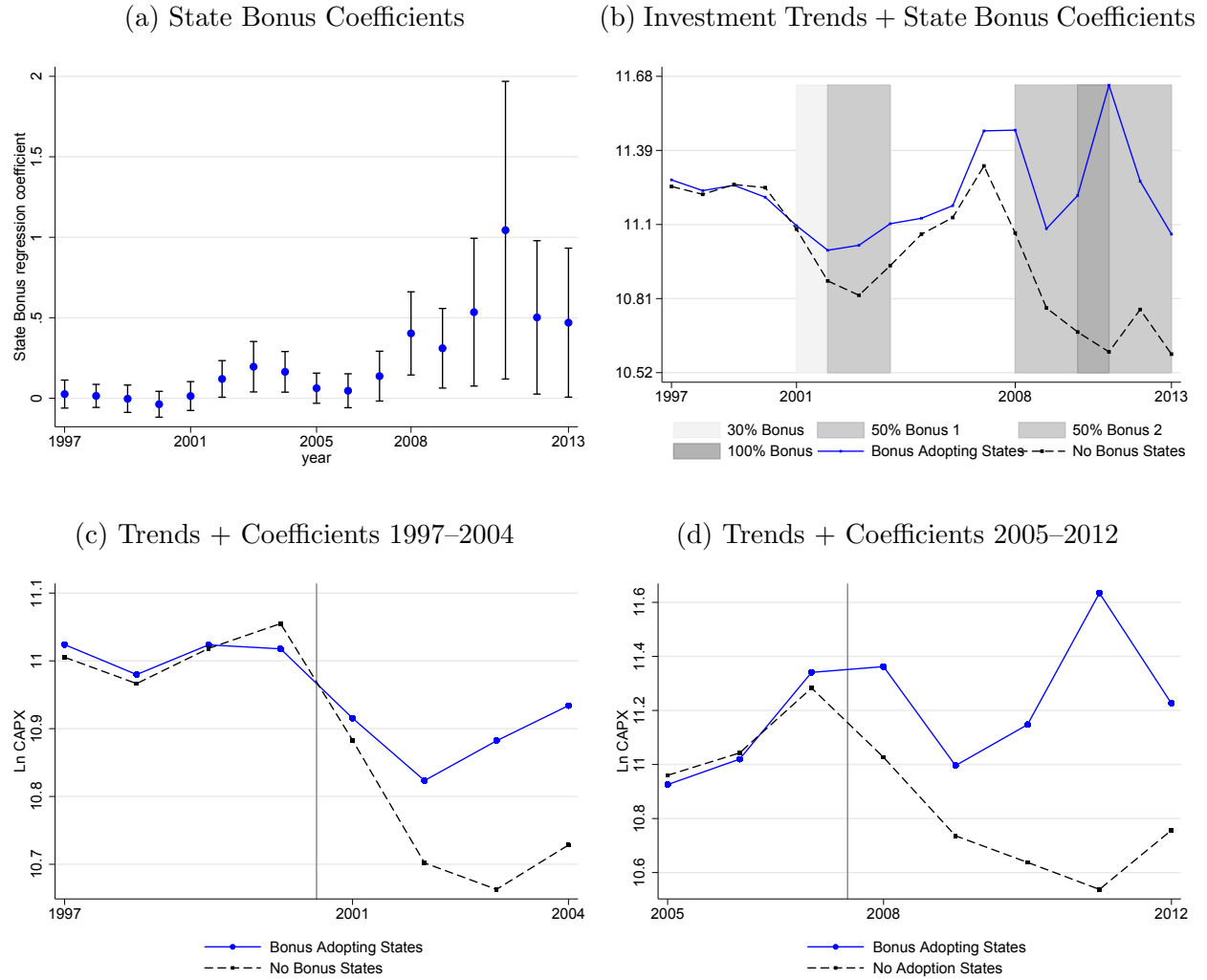
Notes: Figure 3 describes conformity to federal Section 179 rules by states during the years 2001–2012. A dot represents conformity to federal rules. States that always conformed to federal rules are depicted in dark blue. States that only conformed during a subsample of the period are depicted in light blue. States that never conformed are given no dots.

Figure 4: Graphical DD: State Bonus Depreciation Adoption on Investment

(a) State Bonus Coefficients

(b) Investment Trends + State Bonus Coefficients

(c) Trends + Coefficients 1997–2004

(d) Trends + Coefficients 2005–2012

Notes: To produce the coefficients presented in panel (a), coefficients from equation (1) are reestimated after replacing State Bonus with $\sum_{k=1997}^{2014} \beta_1^k \left[\text{State Adoption}_{s,t} \times \mathbb{1}[\text{Year}_k]\right]$. The time-varying coefficients are then plotted by year. Panel (b) adds these coefficients the average investment trends. Panel (c) and (d) are constructed in the same way as panel (b) but focus on adopting and non-adopting states in 2001–2004 and 2008–2010 respectively.

Figure 5: Graphical DD: Effects of State Section 179 Allowance on Investment
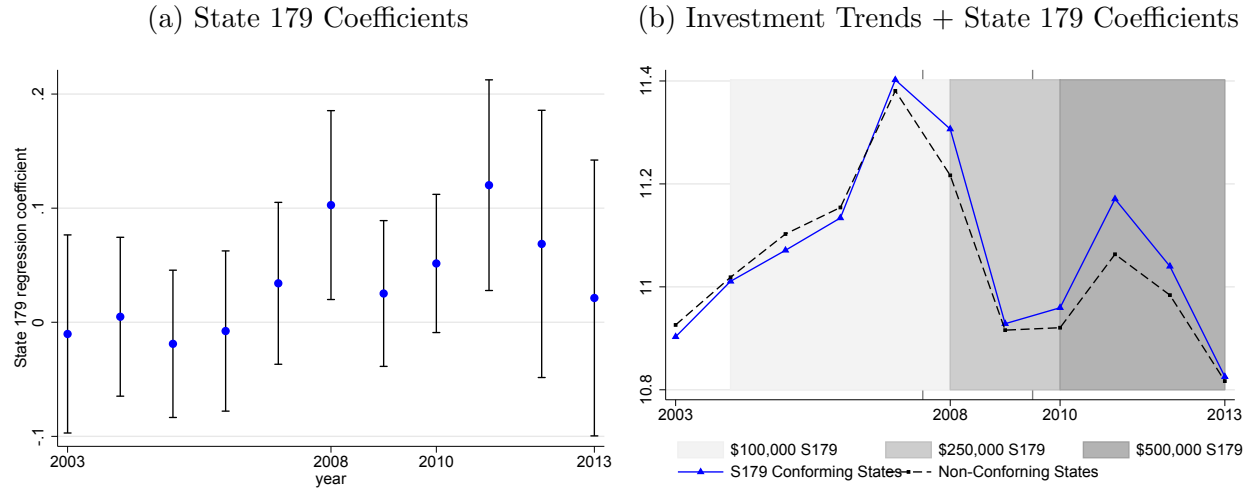
(a) State 179 Coefficients

(b) Investment Trends + State 179 Coefficients

Notes: To produce the coefficients presented in panel (a), coefficients from equation (1) are reestimated after replacing State 179 with $\sum_{k=2003}^{2014} \beta_2^k \left[\text{State Conformity}_{s,t} \times \mathbb{1}[\text{Year}_k] \right]$. Years prior to 2003 are eliminated from the analysis. The time-varying coefficients are then plotted by year. Panel (b) adds these coefficients the average investment trends.

11 Tables

Table 1: Descriptive Statistics

	mean	std dev	25th Percentile	75th Percentile	obs
Policy Variables					
State Bonus (percent)	6.403	17.045	0.000	0.000	13,780
State 179 (thousands)	125.185	166.799	20.000	125.000	13,780
Outcomes					
Investment(millions)	188.765	409.914	17.890	196.998	13,780
Comp per Emp (thousands)	44.663	12.712	36.412	51.278	13,636
Employment (thousands)	16.407	23.956	2.873	20.506	13,780
Output (millions)	2808.085	5017.870	363.884	3046.083	13,618
Control Varibles					
Real GSP per capita(billions)	40.828	9.980	33.686	46.400	13,780
Population (millions)	3.846	5.812	0.311	5.374	13,780
Corp Tax Rate	6.523	2.871	5.500	8.500	13,780
Corp Tax %	0.055	0.036	0.038	0.067	13,780
Budget Gap	-0.019	0.237	-0.137	0.036	13,780
Dem Legislature %	51.431	15.188	40.404	60.000	13,780
Dem Governor	0.443	0.497	0.000	1.000	13,780
Heterogeneity Varibles					
Invest Level (millions)	0.726	1.339	0.143	0.794	12,316
High Tax	0.506	0.500	0.000	1.000	13,780

Notes: Table 1 presents descriptive statistics for each variable used in the analysis. The unit of observation is a NAICS × State manufacturing industry. State Bonus is the state bonus depreciation rate. State 179 is the state Section 179 allowance. Investment is the total value of capital expenditure. Compensation is total salary divided by the number of employees. Employment is the total number of employees, Output is the total value of shipments (sales). Real GSP per capital is the real gross state product divided by state population. Population is the state's population. Corp Tax Rate is the state's to marginal corporate income tax rate. Corp Rev % is the percentage of a state's revenue derived from state corporate income taxes. Budget Gap is the total state deficit as a fraction of total state revenue. Democratic Legislator % is the percentage of democratic state legislators that identify as Democrats. Democratic Governor is an indicator equal to 1 if the governor is a Democrat. Invest Level is total capital expenditure divided by the number of establishments. High Tax is an indicator equal to 1 if the state's top marginal corporate income tax is above 7%, the median value for the sample.

Table 2: Predicting State Adoption of Accelerated Depreciation Policies; LPM Model

	(1) 𝟙(Bonus)	(2) 𝟙(Sect. 179)	(3) 𝟙(Both)	(4) 𝟙(Bonus)	(5) 𝟙(Sect. 179)	(6) 𝟙(Both)	(7) 𝟙(Bonus)	(8) 𝟙(Sect. 179)	(9) 𝟙(Both)
Log(GSP/Pop)	-0.116	0.359	0.287	-0.288	0.597	0.213	-0.151	0.167	0.00878
	(0.316)	(0.298)	(0.337)	(0.209)	(0.416)	(0.307)	(0.193)	(0.399)	(0.435)
Log(Pop)	-0.0455	-0.145**	-0.177***	0.668	-1.370	-0.800	1.968	-0.396	3.536
	(0.0564)	(0.0574)	(0.0511)	(0.581)	(1.038)	(0.950)	(2.451)	(2.262)	(4.513)
Corp Tax %	-0.649	-2.620	-1.492	-0.885	-0.573	-1.314	-0.884	-0.414	-0.876
	(1.615)	(1.710)	(1.469)	(0.733)	(0.526)	(0.798)	(1.227)	(0.741)	(1.143)
Budget Gap	-0.184	-0.182**	-0.143	-0.108	-0.0561	-0.0937	-0.109	-0.0857	-0.116
	(0.111)	(0.0823)	(0.0872)	(0.0923)	(0.0947)	(0.0963)	(0.1000)	(0.100)	(0.113)
Corp Rate	4.164**	-4.378	-1.994	-0.338	-0.450	0.559	0.367	-2.222	0.563
	(1.589)	(2.926)	(2.397)	(1.015)	(1.083)	(1.307)	(1.289)	(2.373)	(1.635)
Dem Leg %	-0.00626**	-0.00722	-0.00667*	-0.00428	0.00288	-0.00448	-0.00429	-0.00467	-0.00647
	(0.00293)	(0.00464)	(0.00350)	(0.00310)	(0.00439)	(0.00313)	(0.00273)	(0.00480)	(0.00482)
Dem Gov	0.106	0.0918	0.186**	0.0286	-0.0488	0.0150	-0.0361	0.0312	-0.0241
	(0.0707)	(0.0759)	(0.0814)	(0.0363)	(0.0422)	(0.0349)	(0.0304)	(0.0421)	(0.0608)
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
State FE				✓	✓	✓	✓	✓	✓
State Trends							✓	✓	✓
Observations	487	348	348	487	348	348	487	348	348
Adj. R²	0.0774	0.162	0.163	0.813	0.836	0.784	0.869	0.907	0.843

Notes: Table 2 uses linear probability models to predict the adoption of accelerated depreciation policies based on state economic, political, and demographic characteristics. The outcome variable in specifications (1), (4), and (7) is the use of bonus depreciation. The outcome variable in specifications (2), (5), and (8) is conformity to the federal Section 179 allowance. The outcome variable in specifications (3), (6), and (9) is both use of bonus depreciation and conformity to the federal Section 179 allowance. All specifications include year fixed effects. Specifications (4)–(6) add state fixed effects. Specifications (7)–(9) add state-specific linear time trends. Standard errors are presented in parentheses and clustered at the state level. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Table 3: The Effect of State Accelerated Depreciation Policies on Investment

	(1) Log(CapX)	(2) Log(CapX)	(3) Log(CapX)	(4) Log(CapX)	(5) Log(CapX)	(6) Log(CapX)
State Bonus	0.180**	0.201**	0.178**	0.270**	0.175**	0.212*
	(0.0788)	(0.0929)	(0.0756)	(0.121)	(0.0766)	(0.106)
State 179	0.0206**	0.0270**	0.0269***	0.0383**	0.0217**	0.0233**
	(0.00782)	(0.0101)	(0.00877)	(0.0152)	(0.00888)	(0.0104)
State Bonus × State 179	-0.0420**	-0.0487**	-0.0429**	-0.0571**	-0.0431**	-0.0457**
	(0.0173)	(0.0203)	(0.0172)	(0.0252)	(0.0171)	(0.0220)
Entropy Balancing; Bonus		✓				
Entropy Balancing; S179			✓			
Entropy Balancing; Both				✓		
Lasso Selected Controls					✓	
No Abnormal Adopters						✓
State NAICS Groups	1022	1022	1022	1022	1022	875
Observations	13047	13047	13047	13047	13108	10849
Adj. R^2	0.0407	0.0338	0.0403	0.0385	0.0430	0.0430

Notes: Table 3 presents coefficients estimates from specifications in the form of (1) describing the effect of State Bonus, State 179, and their interaction on investment. All specifications include year, NAICS × State, and NAICS × year fixed effects as well as state-specific linear time trends. Specification (1) include time-varying state controls variables. Specifications (2) – (4) use the Entropy Balancing technique introduced in Hainmueller (2012) to match adopting and non-adopting states based on economic, political, and demographic characteristics. In specification (2), state that adopt federal bonus depreciation are matched to states that did not. In specification (3), states that adopt federal Section 179 rules are matched to states that did not. In specification (4), states that adopt both federal bonus depreciation and federal Section 179 rules are matched to states that did not. In specification (5), the lasso method is used to select control variables from the state economic, political, and demographic controls and interactions between each of these controls. In specification (6), states that adopt bonus depreciation in an abnormal year are eliminated from the sample. Standard errors are clustered at the state level.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Heterogeneity and Effects on Other Outcomes

	(1) Log(CapX)	(2) Log(CapX)	(3) Log(Emp)	(4) Log(Comp)	(5) Log(Output)
State Bonus	0.0779	0.210**	0.00252	0.0186*	0.0111
	(0.0896)	(0.103)	(0.0279)	(0.00945)	(0.0248)
State 179	0.0236**	0.0248**	-0.00586	0.000512	0.00314
	(0.00902)	(0.00942)	(0.00600)	(0.00157)	(0.00503)
State Bonus × State 179	-0.0249	-0.0520**	0.00513	-0.00590**	-0.00683
	(0.0167)	(0.0213)	(0.00786)	(0.00245)	(0.00787)
State Bonus × Invest Level	0.135***				
	(0.0403)				
State 179 × Invest Level	-0.00542*				
	(0.00286)				
Interaction × Invest Level	-0.0267**				
	(0.0129)				
State Bonus × High Tax		-0.0832			
		(0.113)			
State 179 × High Tax		-0.00969			
		(0.0129)			
Interaction × High Tax		0.0238			
		(0.0276)			
State NAICS Groups	811	1022	1022	1022	1022
Observations	11979	13047	13020	13000	12793
Adj. R^2	0.0427	0.0407	0.0464	0.0562	0.0823

Notes: Table 4 presents coefficients estimates from specifications in the form of equation (1). All specifications include year, NAICS × State, and NAICS × year fixed effects as well as state-specific linear time trends and time-varying state controls variables. The outcome variable in specifications (1) and (2) is Log(CapX). The outcome variables in specification (3), (4), and (5) are Log(Emp), Log(Comp), and Log(Output). Specification (1) includes interactions between State Bonus, State 179, and State Bonus × State 179 with Invest Level. Specification (2) includes interactions between State Bonus, State 179, and State Bonus × State 179 with High Tax. Standard errors are clustered at the state level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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